

ABNORMALLY HIGH TIDES IN THE PORT OF MELBOURNE

By J. E. BRADLEY, L.S., F.V.I.S.

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Abstract

In a period of over twenty years there have been three occasions on which the tide in the Port of Melbourne has risen more than 5 ft. above Admiralty Datum. It is shown that one condition for such high tides is the passage of an intense depression from the Great Australian Bight south of Victoria.

Introduction

The tidal records of the Melbourne Harbor Trust have been examined to determine the frequency of occurrence of abnormally high tides. The meteorological conditions under which these high tides occurred have been investigated. Such abnormally high tides must be considered in the design of structures to combat coastal erosion. When they occur at the same time as heavy rains, flooding in some low areas near the River Yarra occurs because the tide restricts the flow of flood water and tide-affected water backs up through drain outlets.

Tide Records

From November 1934 to April 1956 there have been four records of high water more than 5 ft. above Admiralty Datum (R.L. 0·19 on Melbourne and Metropolitan Board of Works Datum). Two of these were successive high waters. The following table gives particulars of these four high tides:

TABLE 1

	30 Nov. 1934	1 Dec. 1934	8 Aug. 1955	17 Apr. 1956
Time of highest level	21·00	9·15	18·55	19·20
Maximum height above Admiralty Datum	6' 4½"	6' 3"	5' 2½"	5' 4"
Minimum barometric pressure at Melbourne prior to highest tide (in.)	29·37	29·37	29·05	29·41
Estimated barometric pressure at centre of depression (in.)	29·00	29·00	29·00	28·95
Maximum height of water level at entrance to Victoria Dock	6' 5"	6' 3"	5' 5"	5' 9"

The tide heights recorded at Williamstown by the automatic tide gauge are shown for these occasions in Figs. 1, 2 and 3.

Meteorological Conditions

Each of these abnormally high tides was associated with the passage of an intense barometric depression through Bass Strait, over Tasmania and to its south, when very stormy conditions prevailed for several days. The values given for the minimum barometric pressure at the centres of the depressions are taken from

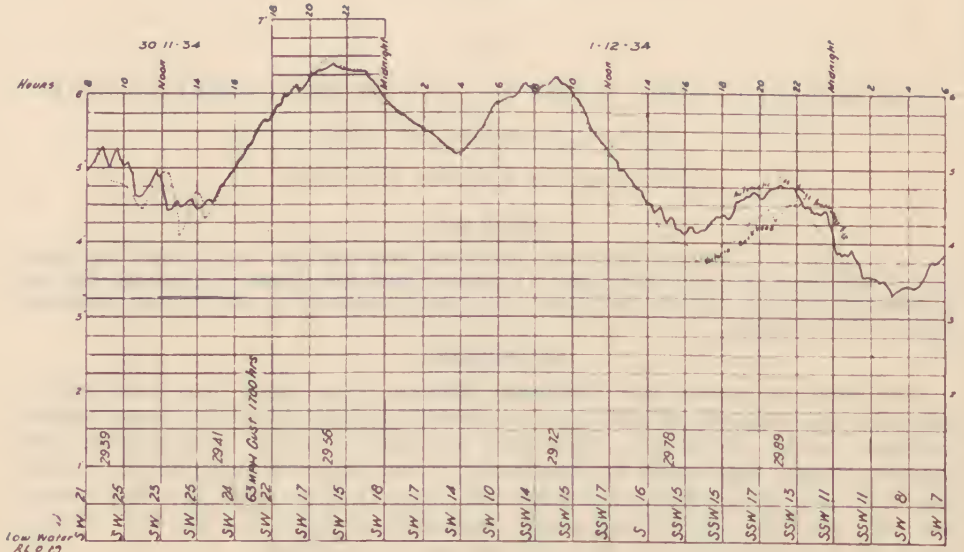


FIG. 1.—Tides on 30 November 1934 and 1 December 1934. Full line shows height of water at Breakwater Pier, Williamstown, and dotted line height at Victoria Dock. Barometric pressure (in. of mercury), wind speed (statute m.p.h.) and wind direction at Melbourne Weather Bureau are shown at the foot of the graph.

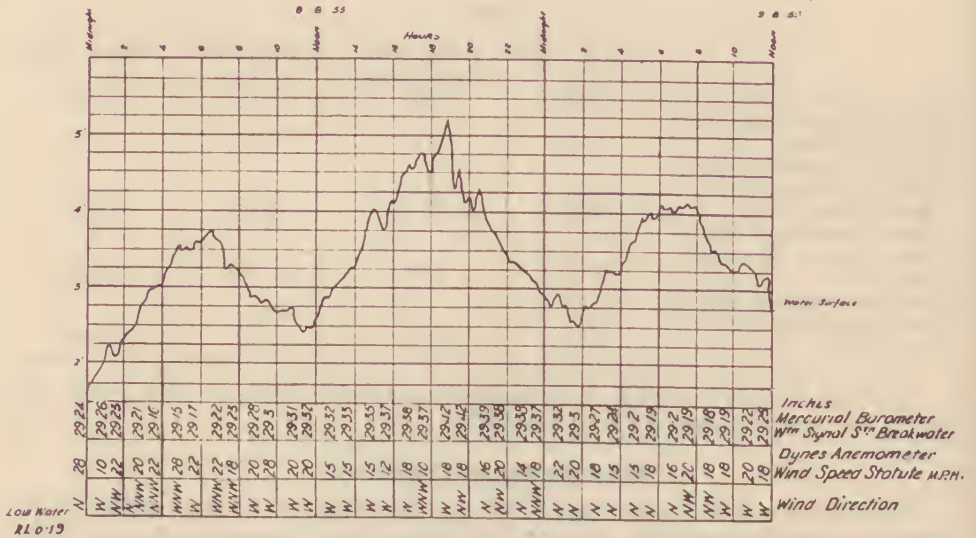


FIG. 2.—Tides on 8 August 1955. Height of water at Breakwater Pier, Williamstown, and weather observations at Signal Station, Breakwater Pier.

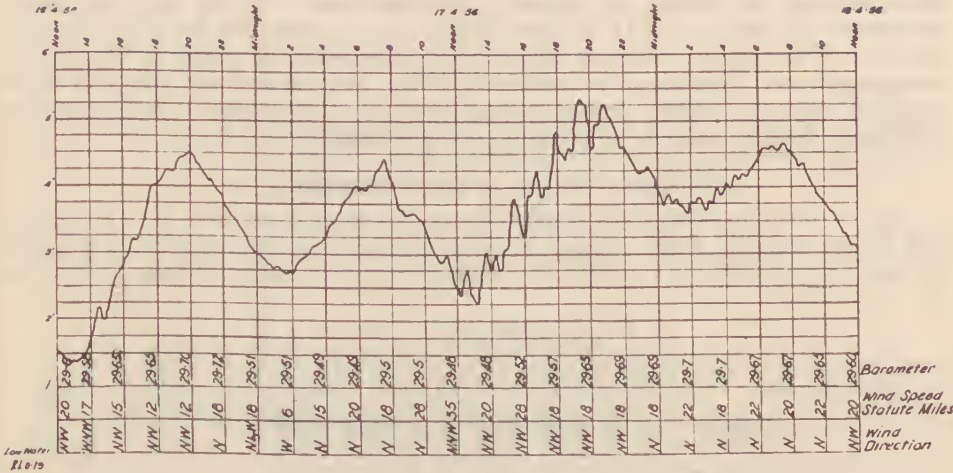


FIG. 3.—Tides on 17 April 1956. Height of water and weather observations at Breakwater Pier, Williamstown.

the charts issued by the Melbourne Weather Bureau and are all about 29 in. of mercury. They are, of course, estimates based on the available observations.

The track of these depressions is approximately a general line from near Albany, Western Australia, to Tasmania and Bass Strait. As they arrive off western Victoria, Melbourne experiences a freshening northerly wind quickly reaching gale force, then changing to westerlies with gusts of 50-60 m.p.h., backing gradually SW and S and then abating. The minimum barometric pressure in Melbourne during the passage of such a depression is between 29.1 and 29.4 in., depending on the intensity of the depression and the proximity of its centre.

The height of the tide at Melbourne is related to the height of the water level in Bass Strait near Port Phillip Heads. For a high water rising to near or over 5 ft. above Admiralty Datum at Williamstown, compared with a normal high water which has a height of about 2 ft. 6 in. above datum, there must be a sufficient rise in level in the waters of Bass Strait to cause enough water to be discharged through the Heads into Port Phillip to raise the general level of the waters some 2 or 3 ft. Theoretically a stationary depression over the open ocean should cause the sea to rise 13 in. for each drop of 1 in. of mercury in the atmospheric pressure. This inverted water barometer effect is not sufficient to explain the rises in water level which occur. In fact, however, the depressions travel in an easterly direction at a rate of some 500 m. per day over the ocean, and the sea bed suddenly rises from 2,000 ff. to 50 ff. in a comparatively short distance west of Tasmania and Bass Strait. Under these conditions greater rises in sea level are to be expected. Thus it seems that the meteorological conditions for the occurrence of abnormally high tides are that a deep barometric depression (pressure at centre about 29 in.) should pass from the Great Australian Bight to somewhere near Tasmania.

To investigate the possibility that a very low barometer reading at Melbourne might be a sufficient indication of these meteorological conditions an examination was made of all very low readings which occurred between 20 September 1943 and 1 October 1953. Each of the fifteen lowest readings was tabulated with the height of the highest high water following. It was found that although the high tides

